

**Interventions to Prevent Sexually Transmitted Infections in University Settings in the
United States: A Literature Review**

by

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Abstract

Sexually Transmitted Infections (STI) have increased within the past four years in the United States according to the Centers of Disease Control and Prevention (CDC). In 2018, it was reported that the United States had 2.3 million cases of sexually transmitted infections diagnosed in the previous year according to preliminary CDC data. Half of these cases are among young adults between the ages of 15 and 24, making university students a high-risk population. This literature review examines STI prevention interventions in university settings in the United States over the past ten years (2009-2019) and seeks to provide recommendations for future public health STI prevention interventions in university settings aiming to reduce rates of STI transmission. A total of eighteen articles were included that met the appropriate parameters for analysis and the data evaluated from this literature review highlight several key themes in intervention design and implementation. First, the majority of STI prevention interventions in this review focus on preventing human papilloma virus (HPV) and the human immunodeficiency virus (HIV) primarily among college-age men. The interventions described in this literature review employ a variety of approaches, including in-person education to increase HPV vaccine uptake and HIV testing, campaigns across campus and online forums to promote HIV testing and increase STI education,

personalized text messages to promote testing, and tailored websites to reduce risk reduction behaviors and promote safe sex practices. Barriers to STI prevention intervention efforts in university settings are also identified and include college student knowledge about STI's, including perceptions, beliefs, substance use, and risky sexual behavior. This literature review points to the need for universities to de-stigmatize STI testing among both male and female students through campus media campaigns, tailored educational resources, and through opportunities to engage with trained medical professionals and peer health advocates in classroom-settings and through the promotion sexual health and testing at every medical visit in campus medical centers.

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1.0 Introduction

According to the Centers of Disease and Control (CDC) the United States has experienced a continuous increase of sexually transmitted infections (STI) over the past four years (CDC, 2018). It was reported in 2018 that the United States had 2.3 million cases of sexually transmitted infections diagnosed in the previous year according to preliminary CDC data. Fifty percent of these cases are among young adults between the ages of 15 and 24, making university students a high-risk population.

According to the CDC the rate of reported cases of chlamydia, gonorrhea, and syphilis increased for both sexes in 15-24 year olds in 2016-2017 in the US. Chlamydia rates were 3,635.3 cases per 100,000 females, and 1,327 cases per 100,000 males. Gonorrhea had the second highest rates among 20-24 year olds, with 648.8 cases per 100,000 females, and 705.2 cases per 100,000 males. Syphilis rates among 20-24 year olds also increased with 7.8 per 100,000 reported cases in females, and 41.1 per 100,000 cases in males. HIV cases in 13-24 year olds for male and females were reported at 8,164 of 38,739 new HIV cases (CDC, 2017). And, HPV's estimated rate of reported cases was prevalence 6,909,000 cases among 15 -24 year olds (CDC, 2013).

Universities and colleges in the United States have developed STI prevention interventions to address the increasing STI rates among college age adults. STI prevention interventions in university and college settings have taken place across the vast array of higher education institutions from small private collages to large public universities. Some STI prevention intervention efforts have been based in university health systems or student health centers, and others are rooted in student organizations. Notable associated risks of acquiring STIs in university settings rely on a combination of behavioral, and sociocultural factors that make university

students a high-risk population (CDC, 2016). While STI prevention efforts are common in university settings, not all universities and colleges provide these services. At the structural level, The American College Health Association provides twelve immunization recommendations for college students of which HPV is the only STI recommendation among this population (ACHA-Guidelines, 2018).

This literature review examines the STI prevention interventions that have been utilized in university and college settings in the United States over the past ten years (2009 – 2019). This literature review identifies key themes in intervention design and barriers and facilitators to STI prevention interventions in university settings and seeks to provide recommendations for future STI prevention interventions in university settings in order to reduce the increasing rates of STI transmission.

2.0 Methods

This systematic review of literature surveyed scholarly articles relevant to the following research question: *What STI prevention interventions have been utilized in university/college settings in the United States to reduce sexually transmitted infections?* This review followed a PICO format to include (P) population, (I) intervention, (C) comparison, and (O) outcome. Four steps were followed to conduct this literature review including: (1) Problem Formulation, (2) Literature Search, (3) Data Evaluation, and (4) Analysis and Interpretation. First, the research problem was formulated based on the research question as: Sexually transmitted disease intervention in college-aged students in the United States. Next, a literature review was conducted following the PICO research question strategy for effective searches that includes: patient/problem/population; intervention/item/exposure; comparison; outcome(s); timing/type of question; and setting) for effective search. The PICO strategy allowed the search algorithm to search for broad elements in my research question, further develop concept clusters, and utilized a variety of synonymous terms to create each concept. Finally, a combination of concepts was identified and utilized for the refined search, and the appropriate parameters to best fit the research question. A total of twenty-four MeSH (Medical Subject Headings) synonym combinations were developed to accurately search the scholarly articles to answer the research question. The search was conducted utilizing three main data base search engines; PubMed, Ovid (PsycINFO), and ERIC (Educational Resource Information Clearinghouse), and a total of one hundred and eighty-nine (189) citations were identified that fit the research question.

Titles and abstracts of the 189 identified citations were evaluated, and articles were selected for inclusion if they included active or past interventions specific to the prevention of sexually

transmitted infections within university settings in the United States from 2009 - 2019. Articles were excluded if they were based outside the United States, if they were treatment studies for specific sexually transmitted infections, and if the intervention took place outside a university setting. Articles were included only if the intervention was conducted in a college or university campus in the United States and if the prime focus of the intervention was to reduce sexual transmitted infections. Additionally, the identified articles were included only if they were published from 2009- 2019 and available via the PittCatt search system. The evaluation of data was conducted once a total of 189 citations were identified; out of the 189 citations a total of eighteen articles met the inclusion parameters for the research question. Table 1 below lists inclusion and exclusion criteria for this literature review and Figure 1 shows the search strategy engaged in this literature review. The following results section of this review is arranged into the major themes identified in these articles.

Table 1. Inclusion & Exclusion Criteria

Inclusion	Exclusion
Active or past interventions specific to sexual transmitted infection prevention	Treatment studies specific for sexually transmitted infections
Interventions conducted in university/college settings	Interventions conducted outside of university/college settings
Interventions in the United States	Interventions outside of the United States
Articles published from 2009-2019	Articles published before 2009

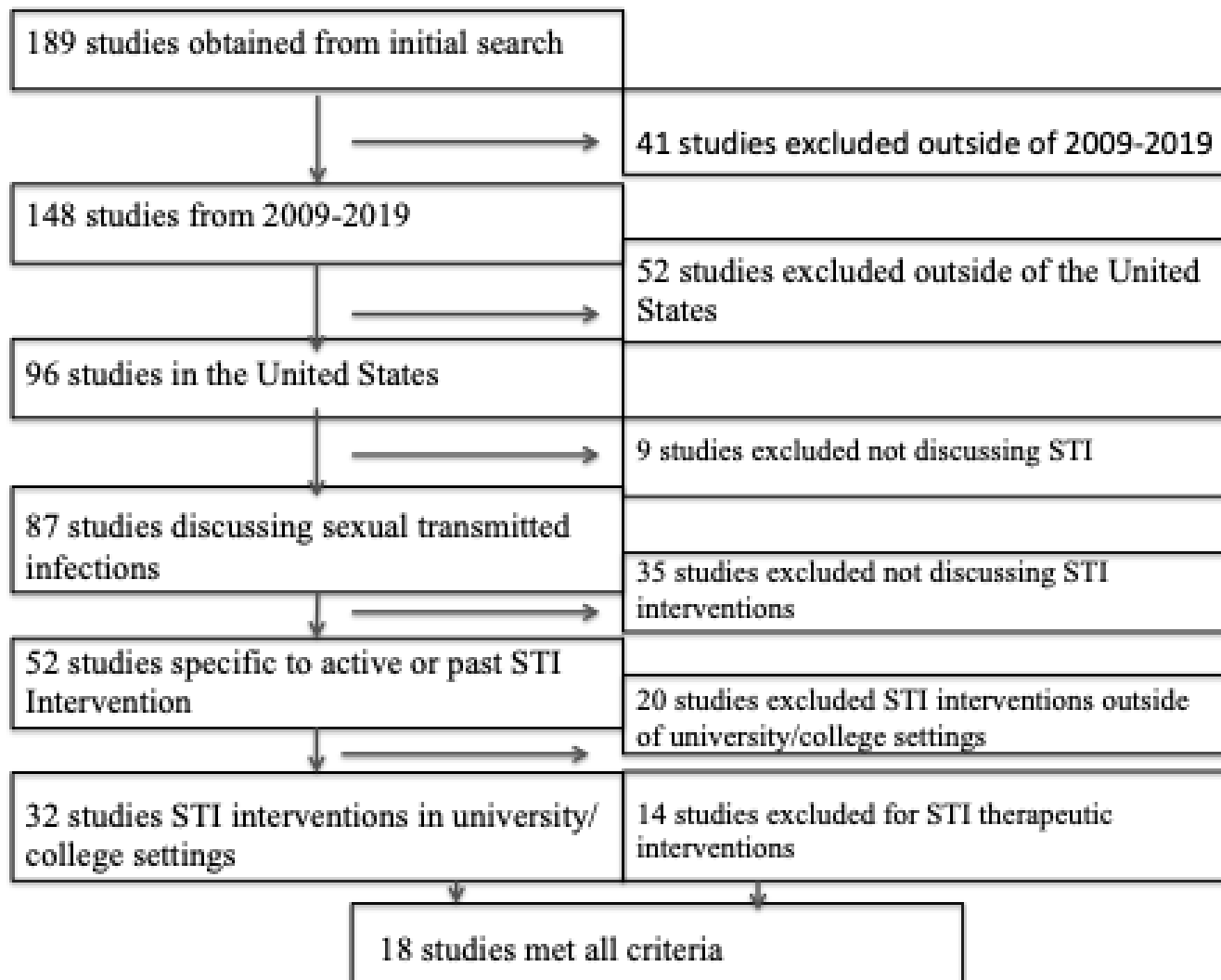


Figure 1. Literature Review Search Strategy

3.0 Results

A total of eighteen articles were included in this literature review that met the appropriate parameters for analysis of STI prevention interventions in university settings in the United States from 2009 – 2019. The intervention design, location, sample size, captured demographics, methods and key findings of these STI prevention interventions are summarized in Table 2. These articles elucidated several key themes of STI prevention interventions in university settings and these themes are characterized and expanded on in Sections 3.1 – 3.3 of this review.

Table 2. Characteristics of Included Publications

Author/Year Published	Intervention Design/Location	Participants	Methods	Key Findings
Robert A. Bell Matthew S. McGlone Marko Dragojevic 2014	Double blind study, United States	N=424 university students	<ul style="list-style-type: none"> – Investigation of beliefs and attitudes about the human papillomavirus and vaccines. – Study entailed reading an editorial on HPV that had appeared in a medical journal and then completing a questionnaire. – Four versions of editorial were created independently by manipulating two characteristics of content design; threat language used to describe viral transmission e.g., “HPV can take advantage of a single act of unprotected intercourse”. – Eight memory-based manipulation checks were included that probed participants’ recognition memory for the threat and immunization. 	<ul style="list-style-type: none"> – Linguistic agency assignment bestows potency to the agent. – Health threat is considered more consequential when describing using language that ascribes agency to it. – Making threats more alarming and medical interventions seem more effective – Participants who read editorial advocating mandatory vaccination against HPV rated the vaccine as more effective and were more supportive of mandatory vaccination. – HPV was judged to be a more severe health concern by participants who read an editorial in which agency was assigned to HPV vaccination.
Rasheeta Chandler Erica H. Anstey Henry Ross Dianne Morrison-Breedy 2016	<ul style="list-style-type: none"> – Historical Black College University – Focus group – evaluate culturally specific HIV prevention information, motivation and behavioral skill needs 	N=32 black females ages 18-24	<ul style="list-style-type: none"> – Semi-structured focus group interview guide was designed to obtain information regarding HIV-related information, motivation, and behavior. – PI probed for experiences to better understand cultural situated familial, social, and relationship contexts that shaped the participants’ knowledge, motivations and behavior skills. 	<ul style="list-style-type: none"> – Access to services and empowerment – Participants expressed their desire for clarity about STIs/HIV prevention, transmission, and testing. – Motivating factors varied but were rooted in social support systems, beliefs about relationship roles, and the need to conform to sociocultural expectations in their environmental surroundings. – Need for behavioral skills such as condom negotiation

Table 2 Continued

<p>Katherine E. Bonafide Peter A Venable 2015</p>	<ul style="list-style-type: none"> - United States University - Randomized Study - Audio-computer- assisted self-interview 	<p>N= 200 unvaccinated male undergraduate students</p>	<ul style="list-style-type: none"> - Audio computer-assisted self-interviewing was used to assess demographics, sexual history and risk behaviors, HPV knowledge, and exposure to information concerning the HPV vaccine. - After survey administration, participants were presented with a visual and audio-based intervention that highlighted information relevant to their assigned condition. - Conditions; BASIC, MALE-INFO, and ALTRUISM - BASIC condition- only essential information provided through CDC, emphasized male specific HIV-related health conditions - MALE-INFO condition- detailed information about medical advancements of head and neck cancers associated with HPV in males, penile, and anal cancers. Intervention explained HPV vaccine offers protection against strains of HPV associated with the described illnesses and offers improved health. - ALTRUISM condition- emphasized the tragic health burden caused by cervical cancer worldwide, concept of herd immunity, and benefits of male vaccination in men and women. 	<ul style="list-style-type: none"> - Male-specific and altruistic motives for vaccination were most accepting and interested in the HPV vaccine. - Findings suggest there may be synergistic benefits of combining self-interested reasons for vaccination with altruistic motives. - Advertising campaigns, public health messaging, and health care providers may achieve a greater impact on male vaccine uptake by stressing both male-specific health benefits. - Brief interventions promoting male-specific benefits of vaccination, as well as benefits to women and society at large, may be the most efficacious in motivating young men to obtain the HPV vaccine.
<p>Hart Blaton Meg Gerrard Kimberly P McClive-Reed 2013</p>	<ul style="list-style-type: none"> - United States University Campus - Randomized Study - Self-read - Fact sheets, and scientific articles 	<p>N= 174 college students, 86 men, 80 women, and 8 no gender reported</p>	<ul style="list-style-type: none"> - Participants were randomly assigned to three experimental conditions; coping pessimism, probability optimism, and information-only. 	<ul style="list-style-type: none"> - Rather than motivating health-protective changes, a boomerang effect was generated. - Vulnerability manipulation was threatening, but the threat

Table 2 Continued

			<ul style="list-style-type: none"> - All participants received fact sheet of risks and consequences of six STIs - Participants completed a 12-item scale measuring willingness to have unprotected sex. 	<ul style="list-style-type: none"> - motivated maladaptive rather than adaptive responding. - Health communicators at times must design messages that focus critical attention on health actions and shine positive light on unhealthy actions. When this balance is achieved, findings suggest such efforts will have the greatest chance on producing adaptive rather than maladaptive actions.
Alaina T Bennett Divya A Patel Ruth C Carlos 2015	<ul style="list-style-type: none"> - United States Public Midwestern University - Randomized Control Study - Online survey 	N=661 female college students ages 18-26	<ul style="list-style-type: none"> - All participants were given a 144-question baseline survey that included knowledge about HPV-related disease and HPV vaccine, options about HPV vaccine including perceptions of susceptibility, and intentions to receive HPV vaccine. - After baseline survey, participants were randomized and directed to an intervention website, or control website. - Three months after randomization, participants were requested to provide feedback on their decision whether to get vaccination against HPV. 	<ul style="list-style-type: none"> - Online tailored educational interventions have similar effects as non-tailored factsheets on HPV. - Three months post intervention, participants with high knowledge HPV vaccination increased, but favorable intention to vaccinate was unchanged
Samira Ali Tamara Al Rawwad 2017	<ul style="list-style-type: none"> - University of Houston, Texas - Campus-based HIV Prevention Intervention 	N= 274 study N= 924 students accessed services	<ul style="list-style-type: none"> - HIV prevention clinic was made available on campus. - Media campaign made available to spread the word out throughout campus for available free services. - Quantitative data collected through demographic survey. - Qualitative data was collected through in-depth interviews, focus groups, ethnographic 	<ul style="list-style-type: none"> - Student leaders and community members identified the need for integrative HIV care that is culturally appropriate, not stigmatizing, and accessible on campus. - Smart Cougars (SC) provided free, culturally appropriate HIV testing, brief intervention, and referrals to students.

Table 2 Continued

			sessions, and participant observation.	<ul style="list-style-type: none"> – SC was age and culturally tailored, individualized and sought to change social norms on campus and in surrounding communities.
<p>Melissa A. Lewis Megan E. Patrick Dana M Litt David C Atkins 2014</p>	<ul style="list-style-type: none"> – United States University – Randomized Control Trial – Web based Assessment/intervention 	N= 480 male participants	<ul style="list-style-type: none"> – In a randomized controlled trial, sexually active college students were stratified by gender and level of drinking and randomly assigned to interventions that were alcohol-only, alcohol-related Risky Sexual Behavior (RSB), combined alcohol and alcohol-related RSB, and control intervention. – Intervention procedures were web-based 	<ul style="list-style-type: none"> – All three PNF conditions were efficacious at reducing normative perceptions for both drinking and alcohol-related RSB outcomes. – Significant reductions, evidence of mediation such that reducing descriptive normative perceptions led to changes in behavior. – Combined PNF condition was more efficacious than either the drinking only or the alcohol-related RSB only conditions.
<p>Kurt H. Dermen Sherilyn N. Thomas 2011</p>	<ul style="list-style-type: none"> – United States University – Randomized Control Trial – Interview-based intervention 	N=154, predominantly white, heterosexual college students (male and female)	<ul style="list-style-type: none"> – Randomized, control trial, of heavy-drinking, predominantly White, heterosexual college students at behavioral risk for infection with HIV and other STIs who were assigned to receive no intervention or a two-session, in-person motivational interview-based intervention. – Three-month retrospective assessments of alcohol use and sexual behavior were conducted at intake and at 3-, 6-, 9-, 12-, and 15-month follow-up appointment. – During follow-up participants who received single-focus intervention 	<ul style="list-style-type: none"> – During follow-up participants who received single-focus alcohol risk-reduction intervention drank less frequently and consumed fewer drinks compared to control participants. – No difference was seen in frequency of intercourse without condom, or number of sexual partners. – Interviewing to reduce alcohol use may not reduce risky sexual behavior among non-minority college students. – Brief motivational intervention targeting HIV risk behavior may have utility for reducing a frequency of unprotected sex in this population.

Table 2 Continued

<p>Robert A. Bednarczyk Guthrie S Birkead 2011</p>	<ul style="list-style-type: none"> - United States - New York State University - Cross-Sectional study - Self – administered anonymous written survey 	<p>N= 207 women</p>	<ul style="list-style-type: none"> - Cross-sectional study data collection through a self-administered, anonymously written survey. - Self-reported coverage of at least one dose of HPV vaccine, and willingness to receive HPV vaccine in the next year. - Women recruited both in university health clinic and classroom settings. - Surveys completed while women were in clinic, and in-class. - Data collection on vaccine uptake barriers, sexual risk factors, having vaginal sex, age at first sexual intercourse, total number or sexual partners, partners prior to college, frequency of condom use, and history of alcohol consumption. 	<ul style="list-style-type: none"> - Barriers to HPV vaccination remain similar to those seen shortly after release of the vaccine. - If vaccination coverage is to be improved, better education about this vaccine, and vaccines in general, should be offered to women. - Role of a physician recommendation and outreach needs to be emphasized. - Strong need to target non-whites for education and vaccination. - Compared to whites, black/African-American women were 33% less likely to have initiated HPV vaccination. - Common reasons for not receiving HPV vaccination included concerns about vaccine safety, and doctors not recommending vaccination.
<p>Wynne E. Norton Jeffery D Fisher 2012</p>	<ul style="list-style-type: none"> - United States University - Randomized Control study - Information-Motivation-Behavioral Skills model 	<p>N= 198 college students</p>	<ul style="list-style-type: none"> - 30-minute online questionnaire assessing various health behaviors. - After questionnaire, participants randomly assigned to one of the intervention conditions; pregnancy, STI, or HIV. - Information in intervention included video on common myths associated with condom use, attitudes on social norms, and risky sexual behavior. - Behavioral skills content provided teaching objective skills and building the self-efficiency necessary to engage in safer sex behavior 	<ul style="list-style-type: none"> - Participants exposed to the pregnancy or STI interventions reported greater condom use and less risky sexual behavior. - Focus of sexual risk-reduction interventions may lead to differential behavior change among young adults - HIV infection may be greater concern than unplanned pregnancy and/or STI (e.g., African American women, gay, and bisexual men).

Table 2 Continued

			<ul style="list-style-type: none"> – Same questionnaire was completed 4, and 8 weeks post baseline. 	
<p>Elizabeth A. Anderson Heather P. Eastman-Mueller 2016</p>	<ul style="list-style-type: none"> – United States – Public Research University – Campus marketing and testing campaign 	<p>N=333 male students</p>	<ul style="list-style-type: none"> – Collaborative partnerships formed the foundation of a campus marketing and testing campaign. – Multifaceted approach to marketing including, residential life staff, women sexual violence prevention centers, Student Health Center (SHC) staff, and peer student organizational leaders. – Marketing strategies targeted men specifically because of high STI rates observed in this institution. – Testing events were conducted Mondays from 10 AM to 2 PM on 5 consecutive Mondays. 	<ul style="list-style-type: none"> – Campaign was effective in reaching men, an at risk population not traditionally emphasized in STI testing. – Students testing positive communicated to their partner(s), as reported by the partners when they attended subsequent testing events. – Development of collaborative group that may support ongoing events. – Health professionals should consider their audience, stakeholders, and partners when creating a public health campaign. – Campaign attracted more male participation and yielded more positive test results than historically seen at other more established campus testing events.
<p>MA Gold GK Tzilos LAR Stein 2016</p>	<ul style="list-style-type: none"> – United States – University College Setting 	<p>N= 572 females ages 13-21 years, at risk for pregnancy and STDs</p>	<ul style="list-style-type: none"> – Computer Assisted Motivational intervention (CAMI) – 9-month longitudinal randomized controlled trial, with multi-site recruitment strategy including clinic, university, and social referrals – 30-minute sessions of counseling at the enrollment, 3-, and 6-month visits consisting of one-on-one brief counseling using an interventionist who was guided by computer generated feedback. 	<ul style="list-style-type: none"> – Among those who completed the intervention, CAMI reduced unprotected sex among an at-risk, minority sample of female adolescents. – Modifying the CAMI to address methodological issues that contributed to high-drop out rates is needed to make the intervention more acceptable and feasible among sexually active predominantly minority, at-risk females.

Table 2 Continued

<p>Suellen Hopfer 2012</p>	<ul style="list-style-type: none"> - United States University - Four-armed randomized controlled trial 	<p>N= 404, 18 to 26-year olds. Male and female participants</p>	<ul style="list-style-type: none"> - Participants were asked to come to a computer lab to ensure that they receive the intervention in an uninterrupted manner, complete the survey in its entirety, and watch a video. - 3 videos: #1 informational video without narratives; #2 informational video campus website providing information about HPV and vaccine; and #3 informational video with no message - Pre- and post-test online survey conducted to assess socio-demographic, sexual activity, and HPV knowledge. - Two months after receiving the intervention, participants were emailed asking them if they received the first HPV vaccine shot. 	<ul style="list-style-type: none"> - At baseline, no significant differences between intervention groups across socio-demographics. - The inclusion of peer and medical expert sources plays a critical role in promoting HPV vaccination among college women. - The combined peer-health care provider message was an effective strategy for increasing HPV vaccination. - The short 4-minute intervention doubled the rate of vaccination initiation. The study met its goal of increasing HPV vaccination.
<p>Erin W. Moore William E. Smith Ashlee R.B. Folsom 2012</p>	<ul style="list-style-type: none"> - United States - University of Missouri-Kansas City 	<p>N= 302 male and female</p>	<ul style="list-style-type: none"> - Randomized Study - Pre- and Post-Survey - Students enrolled in introductory college course were randomly assigned to 1 of 3 brief interventions - Completed pre- and post-surveys assessing knowledge, motivation to use condoms, and condom self-efficacy 	<ul style="list-style-type: none"> - Having an actual person in charge of the learning process resulted in higher knowledge gains and highlighted a student preference for discussion-based learning. - Viewing pictures of sexually transmitted infections and hearing real-life experiences about the consequences of unsafe sex. - Findings will aid in future tailored intervention targeting college students for use with freshmen students at this university
<p>Jennifer Goldsberry Leslie Moore Deborah MacMillan</p>	<ul style="list-style-type: none"> - Southeastern United States University 	<p>N=132 fraternity and sorority members</p>	<ul style="list-style-type: none"> - Descriptive correlational design - Pre- and post-test data was collected from fraternity and sorority members. 	<ul style="list-style-type: none"> - Significant increase in STD knowledge from baseline.

Table 2 Continued

<p>Scott Butler 2016</p>			<ul style="list-style-type: none"> - Instruments measured demographic characteristics, STD knowledge, and attitudes toward safe sex behaviors 	<ul style="list-style-type: none"> - Males were more likely to report attitudes toward risky sexual behavior to safe sex behavior. - As knowledge increased, attitudes became more favorable to safe sex behavior. - STD educational interventions can increase STD knowledge. - College centers must aim to provide sexual health education to all students at every visit.
<p>Mia Liza A. Lustria Juliann Cortese Mary A. Gerend, 2016</p>	<ul style="list-style-type: none"> - Research University in Southeastern United States 	<p>N=1065 male and female participants</p>	<ul style="list-style-type: none"> - Randomized Control Trial - Sexually active college students completed a pretest and were randomly assigned to explore a tailored or non-tailored website, completed a posttest, and were offered the opportunity to order a free at-home STI test kit. 	<ul style="list-style-type: none"> - Perceived risk of STIs increased from pretest to posttest, only in assigned to tailored website. - Exposure to tailored website increased perceived personal relevance, attention to, and elaboration of the message. - Participants in the tailored condition were more likely to order a test kit.
<p>Alice R. Richman 2016</p>	<ul style="list-style-type: none"> - North Carolina - University setting 	<p>N=264 male and female participants</p>	<ul style="list-style-type: none"> - Students randomly assigned to an intervention or control group - Intervention participants received electronic messages about HPV vaccination at baseline, follow-up, appointment reminders, and educational messages - Controls- received standard-care-of messages 	<ul style="list-style-type: none"> - HPV vaccine completion across groups were not significantly different for HPV dose 2 and dose 3. - Mean knowledge score at follow-up for intervention group was significantly higher than at baseline. - No significant differences in knowledge were found for the control group. - Biggest predictor of HPV vaccine completion was the female gender. - Intervention increased knowledge but not vaccine completion

Table 2 Continued

<p>Purvi Mehta 2013</p>	<ul style="list-style-type: none"> - United states - Midwestern University - Randomized-controlled educational trial 	<p>N= 90 male participants</p>	<ul style="list-style-type: none"> - Two-hour educational program - Focus groups- information about HPV vaccine, perceived barriers, correcting misconceptions, & identifying overcoming common barriers. 	<ul style="list-style-type: none"> - Experimental group displayed increased knowledge and greater intent to vaccinate than the control group - Awareness of vaccination-baseline; 97.8% heard of HPV but only 91.1% were aware of a vaccine, gay and bisexual men displayed higher rates of vaccine unawareness. - Vaccine acceptability – control group were 37.8% in favor of intent to vaccinate and 28.9% were strongly in favor to vaccinate in experimental group. - Reductions in barriers were more likely predictors in vaccination than cues to actions or increasing susceptibility. - Not making HPV and HPV vaccine a daunting item in their minds may contribute toward acceptability of vaccine versus opposite effects.
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3.1 Human Papilloma Virus and Human Immunodeficiency Virus Prevention

Interventions for Men

Over the past ten years, universities in the United States have developed interventions for young adults, urging them to increase their knowledge on STIs, increase vaccine uptake rates of the Human papilloma virus (HPV) vaccine, promote STI testing, and educate about HIV prevention and safe sex practices. While many STI prevention interventions in university settings have sought to increase awareness and testing for both male and female students, the majority of STI prevention interventions in this literature review focus on preventing, human papilloma virus (HPV), and increasing knowledge of the human immunodeficiency virus (HIV) primarily among college-age men. From the eighteen articles in this literature review nine out of eighteen exclusively focused on HPV, HIV, and general STI knowledge. Four of these nine articles strictly focused on HPV and vaccine uptake among males, three focused on HIV testing and knowledge among males, and two promoted increased knowledge of STIs among males in university settings.

HPV prevention interventions have been implemented in university settings for over fifteen years since the approval of the HPV vaccine. HPV is the cause for cervical, vaginal, vulvar, and anal cancer among women; and penile cancer in men. It is also the cause of genital warts for both sexes. Presently, there are three approved and effective vaccines against several types of HPV. Vaccine type HPV2 offers protection against types 16 and 18, vaccine type HPV4 offers the same protection against types 16 and 18, and an additional two HPV types that prevent 90% of genital warts. Vaccine type HPV9 protects against types 6, 11,16, 18, and an additional five oncogenic types 31, 33, 45, and 58. Because HPV vaccination provides maximum protection if administered

prior to sexual debut, the Advisory Committee on Immunization Practices (ACIP) recommends HPV4 administration to males and females aged 11 and 12, with a strong catch-up-vaccination up to age 26 (Richman, et al, 2016). Although vaccination against HPV-related cancers is a significant breakthrough, completion rates are low, specifically in young men (Richman, et al, 2016). This literature review identifies several interventions that strive to increase HPV vaccine uptake for the entire university community but with a primary focus on addressing the low uptake and completion rates among young men.

Interventions for HPV vaccination uptake mainly targeted young males and females through their electronic devices. Electronic interventions included computer assisted, mobile messages, and 30-minute video interventions followed by linkage to a peer health provider. To target young men, computer-assisted informational interventions were designed to highlight male-specific health benefits of HPV vaccination, and altruistic motivations, including benefits to female partners and broader health benefits at a global level (Bonafide, et al, 2015). This intervention assessed the efficacy of using either altruistic motives or male specific health benefits that were observed to enhance relevant vaccination motives individually. In a point scale for an HPV vaccine acceptance rating, 1.5 – 5, altruism plus male- info rated 4, compared to altruism intervention by itself at a 3, and male info at 3 (Bonafide, et al, 2015). Findings suggest that the combined effects of including content for both male altruistic and male specific information maximized vaccine acceptance in college age males. This intervention approach succeeded at increasing interest and acceptance of the HPV vaccine. This intervention included the promotion of male-specific vaccination messages through advertising campaigns. Healthcare providers were found to achieve a greater impact on male vaccine uptake by stressing both male specific benefits, combined with altruistic motives for vaccination (Bonafide, et al, 2015).

In another intervention, mobile messaging promoted the completion of three dose HPV vaccine uptake (Richman, et al, 2015). Messages included encouraging knowledge of HPV and vaccine schedules and reminders for upcoming vaccine dose for college students accessing university campus health clinics. In this intervention text message reminders did not significantly affect completion rates of vaccination, but female students were five times more likely to complete the second dose of the HPV vaccination, compared to male students (Richman, et al, 2015). Electronic messaging seemed to increase knowledge but did not translate into completion of the vaccine regimen (Richman, et al, 2015).

An intervention by Bednarczyk identified that large proportions of university students express continuous concerns regarding vaccine safety and increasing knowledge by itself is insufficient to increase vaccine uptake (i.e., behavior change) (Bednarczyk, et al, 2014). Another intervention aimed at increasing vaccination rates included a thirty- minute vaccine narrative intervention followed by an in-person intervention with a peer-health advocate. Results show that the combined peer-health care provider message was an effective strategy for increasing HPV vaccination in university settings. This short, four-minute intervention nearly doubled the rate of vaccination initiation in male participants (i.e., receiving the first of three HPV vaccine shots) (Hopfer, 2011).

The most efficacious STI prevention intervention found in this literature review aimed at preventing HIV transmission by engaging college students in an HIV prevention intervention program (Ali, et al, 2017). Student leaders and community members identified a need for integrative HIV care that is culturally appropriate, non-stigmatizing, and accessible on campus. A university-community-based HIV prevention intervention was developed and implemented to achieve this goal. The program strategically created a brand name Smart Cougars, in honor of

Shasta the cougar school mascot. This branding provided visibility around campus, and also contributed to increased activity online to better reach the student population through Facebook, Instagram, Snapchat, and Twitter. This intervention was able to collaborate with other campus-wide projects and added value to their campus events by adding a sexual health component at every event. Smart Cougars became the first program in the history of the university to provide a free bundled service that included substance abuse and mental health counseling and referral interviews, along with free education and HIV testing in a discrete space. Smart Cougars' outreach created a high demand for their services. Within the first couple months of the program's initiation, 274 students accessed Smart Cougars' services, which include getting tested for HIV. Prior to this intervention, more than half of participants had never been tested for HIV. The program was appropriately tailored for the students' specific needs and was welcomed among participants due to the ease of accessibility of HIV testing procedures. The students gained a sense of relief of what used to be a fearful process of getting tested for HIV, now trusting the testing procedures. Testing was perceived as a stressful process of waiting for days for test results and came attached with increased anxiety. Now testing became a one-day process that reduced anxiety and promoted testing among other students. Smart Cougars was widely accepted because it was individualized, provided in-depth education and resources, and developed a brand name that assisted with the program sustainability. Smart Cougars provided free, culturally appropriate HIV testing, brief intervention, and referrals to students and community members that may have not had access to such services before (Ali, et al, 2017).

Another campus-wide intervention included a media campaign that used an integrated public health approach exposing STI rates among college populations to increase sexually transmitted infection awareness and testing among university men. This intervention consisted of

collaborative partnerships with the university marketing department that formed the foundation of a campus marketing and testing campaign. This intervention promoted college men to access testing services through the campaign slogan “Man-up-Monday”. The campaign yielded positive results, with an increase in campus STI testing. A total of 333 students were tested over five consecutive Monday’s. The campaign was effective in reaching men, and efforts were made to ensure the entire campus community perceived testing events as sex-positive and inclusive (Anderson, et al, 2015). Another intervention striving to reduce STI took the form of a web-based intervention that tailored the content of a brief web-based intervention designed to promote STI testing in university settings. Students were randomly assigned to either explore a tailored website that promoted testing that was specifically designed for college-aged students, or a non-tailored website with general information about STI’s from the CDC. Both groups were offered the opportunity to order a free at-home STI test kit or be referred to a university health center for STI testing. The study revealed that the age-appropriate tailored website was more successful in promoting STI testing to students with the free at-home STI kits. This study suggests that students are more accepting and comfortable of testing for STIs when given the opportunity of a free at home test kit, versus getting tested in the university health center. Thus, the intervention provided insight for a positive intervention design, and effectively promoting STI testing for university students (Schmitt, et al, 2016). This literature review highlights several examples of STI prevention interventions in university settings and points to a focus over the last ten years on overcoming barriers to STI prevention primarily among young men in university settings.

3.2 Perceptions of STIs, Vaccine Safety, and Risky Sexual Behavior in University Settings

This literature review identified several barriers to STI prevention interventions in university settings and these barriers include college student knowledge about STIs, including their perceptions, beliefs, and understanding of risky sexual behavior. One major barrier to the promotion of STI knowledge, testing, and prevention is the negative perception and stigma of STIs among university students. Communicating to young adults about safe sex practices and promoting STI knowledge in order to prevent STI transmission is often complicated by fearful perceptions and attitudes among students that may lead to high-risk sexual behavior because of their lack of knowledge and understanding. These negative perceptions create obstacles to decrease STI transmission and risky sexual behavior (Balton, et al, 2013).

One intervention assessed the efficacy of the communication of health risks to university students (Balton, et al, 2013). People are often optimistic about their current health and their ability to maintain their health. As a result, when health interventions seek to communicate health risks, such as advocating condom use as a safe practice to reduce STI transmission among college students, the intended audience of young adults may find fault in messages that are designed to convince them that they should worry. This results in a “boomerang effect” previously described in persuasion literature (Hovland, Janis, & Kelly, 1953) where young people “embrace” their personal risk by reacting in self-justifying ways that may put them at greater risk in the future (Balton, et al, 2013). STI prevention interventions must design messages that focus critical attention to unhealthy actions, while also focusing attention and promoting healthy actions. In this intervention, Balton found that coping with vulnerability triggered a boomerang effect, but when attention to vulnerability was paired with a self-affirmation; this procedure promoted greater commitment to using condoms, and was assessed by behavioral willingness ratings and condom

purchasing decision (Balton, et al, 2013). When an intervention achieves this balance, there is a greater chance of producing adaptive rather than maladaptive reactions towards safe sex practices (Balton, et al, 2013).

Risky sexual behavior has been defined as a person having multiple or casual partners while partaking in unprotected sexual activity. Condom use interventions to reduce risky sexual behavior have been developed, implemented, and evaluated. Despite an increase in condom use, interventions to prevent STIs in young adult populations have struggled. Research indicates that certain negative outcomes of unprotected sexual intercourse are perceived as more likely and relevant than others (Norton, et al, 2012). In one intervention, there was higher concern of preventing pregnancy rates than contracting STIs and less of a concern of becoming infected with HIV (Norton, et al, 2012). College students have reported being more motivated to use condoms for unplanned pregnancy or prevention of herpes specifically, with herpes being the only STI students in this intervention felt they had sufficient knowledge about. In this intervention students were relatively less motivated to use condoms for HIV prevention: “When I think of using a condom, I think of preventing pregnancy, not preventing AIDS’ or ‘I don’t want to get pregnant so I’ll use a condom, AIDS isn’t really that common but herpes is all over the place” (Norton, et al, 2012). Norton found that because of common perceptions towards risky sexual behavior, sexual risk-reduction interventions should focus attention primarily to prevent pregnancy and the reduction of STIs transmission may be more efficacious among young adults than interventions solely focused on preventing STIs and HIV infection.

Other barriers to STI prevention interventions that emerged in this literature review include cultural, religious beliefs and attitudes. In one intervention targeting Black college women, researchers found that despite having adequate increased HIV knowledge from the intervention

designed to promote condom usage, testing, and increase HIV knowledge, female students continued to have unprotected sex. Female students did not perceive themselves to be at risk for HIV, and did not access testing services made available through their university settings. In this intervention, motivating factors to reduce risky sexual behavior varied but were rooted in social support systems, beliefs about gender and relationship roles, including condom negotiation, and a need to conform to sociocultural expectations around condom-use (Chandler, et al, 2016). Females reported feeling pressure to prove one's value and trust to significant other by not utilizing condoms during sexual intercourse. Females reported the need to conform to sociocultural expectations about relationship roles and stop condom usage once in a committed relationship with a significant other, thus exposing females to STI transmission (Chandler, et al, 2016).

Substance use in university settings is another barrier to STI prevention interventions and is a facilitator for risky sexual behavior. Alcohol consumption is common among college students. Data suggests college students who consume more alcohol have less knowledge regarding STIs (Goldsberry, et al, 2016). Alcohol use and risky sexual behaviors often co-occur and increase the transmission of STIs. There is some evidence that on days college students drink, they are more likely to engage in sex with a greater number of sexual partners or sexual behaviors (Lewis, et al, 2015). One web-based intervention of personalized normative feedback and alcohol-related risky sexual behavior demonstrated that not consuming alcohol prior to sex eliminates the impact of alcohol on judgment and decision-making in sexual situations (Lewis, et al, 2014). This intervention was designed to promote the decrease of alcohol consumption among male and female college students in order to prevent risky sexual behavior. Findings from this intervention from post survey analysis demonstrated that while the number of alcoholic drinks that college students consumed did not decrease, female students reported that increased knowledge of potentially risky

sexual behavior to have a positive influence on decision-making related to sexual activity compared to male students (Lewis, et al, 2014). In another intervention, a brief online intervention was utilized to reduce high-risk drinking among college students (Dermen, et al, 2012). Similarly, this intervention did not reduce the amount of alcohol consumption in participants, however knowledge of STI increased. In this example, however, alcohol-focused motivational interventions to reduce alcohol use did not result in a behavioral change regarding casual sex among male students (Dermen, et al, 2012). While this literature review highlights the many barriers faced by STI prevention interventions in university settings, the following section highlights the best practices for educational strategies in STI prevention interventions highlighted in this review.

3.3 Educational Strategies in STI Prevention Interventions

This literature review highlights a variety of educational strategies to promote STI knowledge and decrease STI transmission. Universities employed different methods when educating college students about STIs, vaccines, and testing. The interventions included in this literature review promote the need to evaluate students' preferences for learning about sexual health in order to develop the most efficacious interventions in university settings. These interventions engaged different methods to educate about STI prevention including: media advertisement campaigns, text messaging campaigns, online-portals where student could access STI information, online age-specific portals, lecture-driven presentations by health educators or guest medical professionals in a closed classroom setting, STI-specific fact sheets distributed throughout the university, one-on-one consultations with physicians or health care advocates, and an HIV intervention prevention program (Gold, 2016).

One intervention found the most effective educational strategy is to have an in-person lesson with students to increase knowledge in university settings (Moore, et al, 2012). This strategy highlighted the student's preference for discussion-based learning, viewing real-life pictures of sexually transmitted infections, and hearing real-life experiences about the consequences of engaging in unsafe sex practices (Moore, et al, 2012). Another intervention among college students to promote increased knowledge, found that students are more willing to engage with educational programs when it is within the comfort of their own home and on their own time. In this intervention, educational interventions through online-portals and text messaging had the higher retention rates, and longer online activity was recorded (Gold, et al, 2016, Bennett, et al, 2015). Other interventions included one-on-one brief educational lessons and pre- and post-assessments to evaluate STI prevention knowledge. While students seemed comfortable at the beginning of the intervention phase, this intervention experienced a high loss to follow-up when the final intervention phase assessment was an in-person assessment with a health care interventionist. It was concluded that students may at times not complete interventions for fear of disappointing the interventionist for the lack of increased knowledge or behavior change (Gold, et al, 2016).

One intervention's educational strategy utilized alarming vocabulary to advocate for HPV vaccination. The language used to describe viral transmission included: "HPV has infected 20 million Americans and will contaminate 6 million of our fellow citizens this year. All young people need to protect themselves by getting an HPV vaccination" (Bell, et al, 2014). The promotion of vaccination language included statements such as: "HPV is treacherous, but currently approved vaccines can effectively protect against it." Participants who read HPV fact-sheets that included alarming language for the need for HPV vaccination rated the vaccine as more effective and were more supportive of mandatory vaccination when threatening language was used. Participants in

this intervention inferred that HPV must truly be a threat if medical authorities are advising people that they need to protect themselves with the HPV vaccine (Bell, et al, 2013). Unfortunately, this intervention comprised various types of word cues, phrases, and expressions, and the researchers found it difficult to identify which specific alterations of language produced the effects observed (Bell, et al, 2013).

One successful educational strategy involved including sexual health information as part of routine and more specialized healthcare visits. In this intervention, despite their reason for healthcare appointment, students were briefed about sexual health, STI prevention practices, including STI testing options at the university health center. This strategy resulted in an increase in student STI knowledge (Balton, et al, 2013). This example points to the need for health centers to provide sexual health education to all students at every visit and must ensure privacy is maintained throughout the educational process in order to provide the most benefit (Balton, et al, 2013).

4.0 Discussion

This literature review examines the interventions that universities have implemented to reduce sexual transmitted infections affecting young adults on their campuses and across the United States over the last ten years. The review highlights interventions that strove to increase vaccine uptake rates for HPV, increase STI knowledge and testing for HIV, promote safe sex practices, and address perceptions of STIs and risky sexual behavior. These interventions utilized several educational strategies and demonstrated best practices for promoting safe sexual health and preventing STIs in university settings. The most effective interventions for preventing HPV and HIV were conducted by using tailored informational websites, informational text messages, advertisement campaigns around campus and online, STI prevention programs, and interactions with peer health educators or physicians. The most effective educational strategies to increase STI knowledge also utilized personalized text messages, online-portal informational websites, campus-wide fact sheets about STI's, and one-on-one brief educational sessions with physicians and peer health educators.

Interventions that increased vaccine uptake rates for HPV in this literature review increased knowledge of HPV risk in college aged adults through personalized online informational forums, text messages, peer health educators, and students communicating directly with physicians. Yet, barriers to STI prevention intervention focusing on college students remain, including concerns about vaccinations. Knowledge increase was observed through interventions for STIs, but vaccine uptake did not increase. Studies suggest the continuous need to engage male students because there is resistance to vaccine uptake and completion rates. Interventions identified that large proportions of the target population express continuous concerns regarding vaccine safety, and thus increasing

knowledge by itself is insufficient to increase vaccine uptake (i.e., behavior change) (Bednarczyk, et al, 2014). These interventions recognize the need for healthcare professionals to have conversations specifically about HPV vaccine with young adults and if they identify readiness, immediately provide the initial vaccine series (Benet, et al, 2015). There seems to be a resistance towards vaccine uptake among college students, despite increased knowledge from multiple interventions. Efforts should continue to increase knowledge and promote vaccination. Interventions in this literature review demonstrate that when students communicate directly with a physician, and educational messages about their sexual health are provided, they engage and want to utilize the resources available such as vaccines and condoms (Hopfer, 2011). Also, when students received the alarming vocabulary educational intervention for HPV vaccine uptake, they not only wanted to engage in vaccine uptake, but also recognized that younger individuals could also benefit from the vaccine (Bell, et al, 2014).

Increasing knowledge of STIs and promoting HIV testing in college-aged adults has been another priority for STI prevention interventions in the US over the last ten years. These interventions demonstrated increased knowledge about STIs, transmission, and prevention, but HIV testing continues to be a fearful process among this population, as seen in other interventions outside of the Smart Cougars intervention prevention program. Despite interventions promoting free testing, and counseling, students continue to fear the process of going into a health center or clinic to get tested. However, when students have the option of doing this in the comfort of their own home, they are more willing to engage with an at-home test kit. (Lustra, et al, 2016) It is important that university health systems offer the necessary support for those students testing at home.

Common knowledge among college-aged students for safe-sex practices is focused solely on preventing pregnancy by utilizing condoms. A noted driver that is known to increase risky sexual behavior is alcohol consumption. Interventions have strived to decrease alcohol consumption while increasing STI knowledge among college students. Yet, there is little interest in college-aged students to decrease alcohol consumption in order to reduce risky sexual behavior. Because, alcohol consumption is high in college students, universities should incorporate strategies to increase knowledge of STI risks when engaging in of alcohol consumption for male and female students. Like the Smart Cougars intervention, offering bundled services that included substance abuse and mental health counseling and referral interviews, along with free education and STI testing in a discrete space is important. Perceptions towards living a safe sexual life focus on preventing unwanted pregnancies, and transmission of STIs comes secondary. Condom negotiation is challenging for many women, more so when alcohol consumption is involved. Universities should continue to promote condom use but should strive further to target females. Female students would benefit from training in condom use negotiation, and promotion of condom purchasing for their future sexual encounters. [Chandler, et al, 2016]

The most effective educational strategies to reduce STIs in university settings for behavior change are engaging students directly with physicians or peer health advocates one-on-one. The most effective educational strategy for increasing knowledge among college students in this literature review are online methods. Students are accepting and open to learning new knowledge about STIs in their own time, from their electronic devices. However, vocabulary tailored to this population should be considered to promote education and STI prevention in a non-judgmental way. It is important to promote individual benefits, but this literature review points to the need to promote the impact of one individual, and how their change can benefit future partners, and the

community as a whole. It is important to not only center educational interventions individually but also promote a community benefit and change through safe sex practices.

Several limitations of this literature review should be addressed. The first limitation is the scope of literature available through the University of Pittsburgh and its access to relevant literature through the available search engines, PubMed, Ovid, and ERIC. Several articles were not available for review because the university did not have access to them, and their absence from the review could have influenced the discussion and conclusions. The second limitation is the inclusion and exclusion procedure, with articles excluded if they were outside the ten-year period from 2009-2019. Articles published prior to 2009 were excluded and could have provided valuable findings to the research question. The third limitation is the exclusion of articles describing interventions outside of college and university settings, such as community-based interventions that address STI transmission and knowledge. Finally, the fourth limitation was the exclusion of interventions in college and university settings in countries other than the United States. Analysis of intervention methods in sexually active college students in other countries could have provided good comparison results and could have provided insight to what work has been done, and what has been efficacious in the target population.

Despite these limitations, this literature review offers important recommendations for future public health STI prevention interventions in university settings aiming to reduce rates of STI transmission. University students display an increase of STIs knowledge; understand the importance of the HPV vaccine, and increased knowledge of safe sex practices including STI testing. Unfortunately there is continuous stigma associated with STI testing. As universities continue to implement interventions among young adults to reduce the transmission of STIs, there are a few things that can be beneficial to incorporate moving forward. Based on the data

analyzed from this literature review and the effective intervention designs, several measures can be undertaken to decrease STI transmission. Universities should aim to de-stigmatize STI testing by promoting STI testing dialogue around campus. This may be achieved if intervention approaches are designed through online media campaigns around campus year-round that promote STI testing. Mobile messages delivered by the university to every student, providing regular STI knowledge, as well as STI statistics for young adults, followed by an online tailored STI website that can further provide information regarding STIs, and promote university services available to students is another important recommendation. University health centers should train medical staff to always bring a sexual health component to every medical visit to every student, and advocate for the first dose of HPV vaccine if student qualifies. Medical health centers should continue to promote testing, but also provide an at-home test kit option for students, followed by a referral. Finally, universities should develop a financial incentive for STI testing to all students.

5.0 Conclusion

This literature review provides insight to what interventions have been designed, implemented, and analyzed over the past ten years to reduce STIs in university settings in the United States. It highlights the most relevant literature to date and describes the successes and setbacks that interventions have experienced in decreasing transmission of STIs in university settings. This review summarizes valuable findings that can be expanded upon moving forward in the next years on to successfully increase STI knowledge and promote behavior change towards safe sexual health in university settings. STI prevention interventions in university settings in the United States must continue to de-stigmatize testing, promote knowledge, and increase safe sex practices. Understanding and strategically promoting these interventions may result in reduction of STIs in this population. Communicating with college-aged adults individually seems to promote behavioral change when they access medical care, in or outside the university and promote vaccine uptake, and safe sex practices is one of the most effective strategies. Continuous campaigns on campus and online are effective ways to reach this population at the community level by providing information individually and accessibly. Furthermore, universities need to promote safe sex practices through the student body with media campaigns that are tailored and rooted in the university community to encourage dialogue about STI prevention.

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